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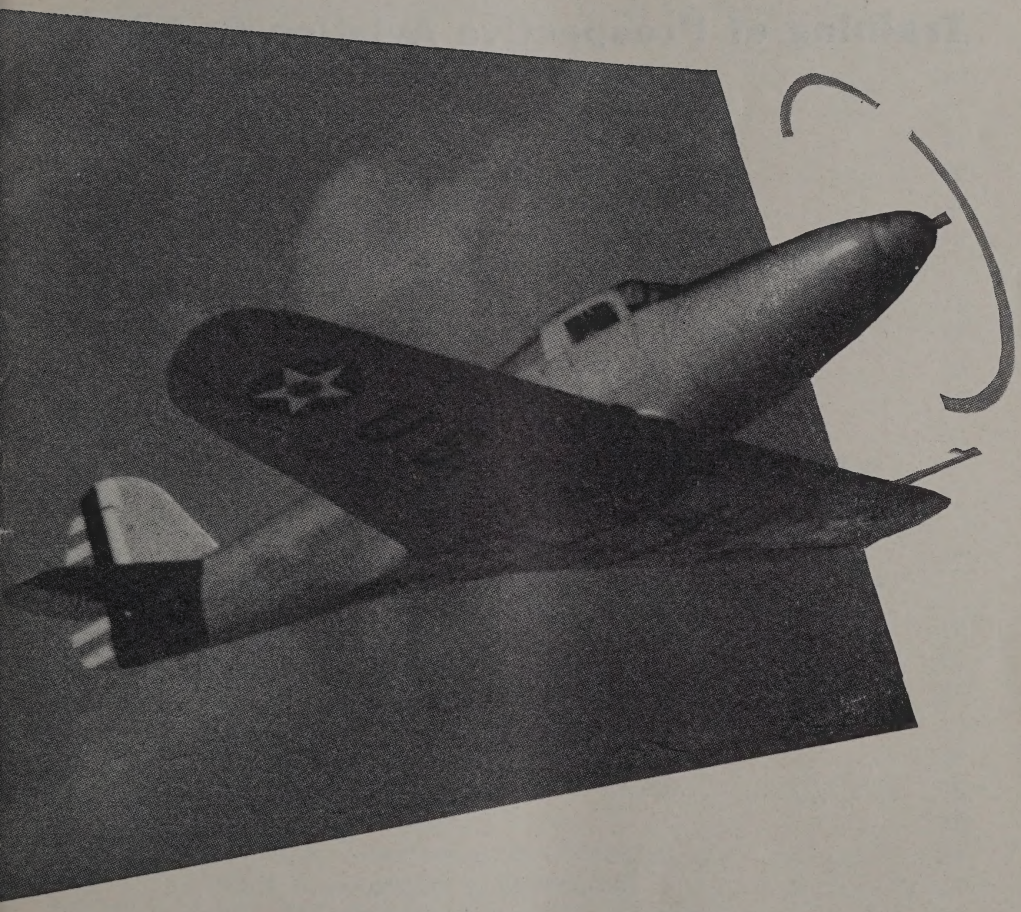
Pre-FLIGHT AERONAUTICS in SECONDARY SCHOOLS



Federal Security Agency U. S. OFFICE OF EDUCATION

An Administrative and Instructional Guide With Special Reference to the Preliminary Training of Prospective Aviation Cadets

Federal Security Agency ..... Paul V. McNutt, Administrator
U. S. Office of Education ... John W. Studebaker, Commissioner

United States Government Printing Office ..... Washington : 1942

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FOREWORD

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Pre-Flight Aeronautics in Secondary Schools (Leaflet No. 63) is a companion publication to *Pre-Aviation-Cadet Training in High Schools* (Leaflet No. 62) released by the U. S. Office of Education in May 1942. Just as Leaflet No. 62 stressed what high schools might do in pre-aviation training during the summer session, so the present publication offers suggestions regarding a type of pre-aviation program which secondary schools may wish to consider for the coming school year.

In preparing these publications the U. S. Office of Education has worked closely with representatives of the Army, the Navy, and the Civil Aeronautics Administration. Indicative of the attitude of the Navy is the following paragraph quoted from a letter dated May 29, 1942, and signed by Hon. Artemus L. Gates, Assistant Secretary of the Navy for Air:

> We are convinced, that in addition to the basic emphasis on mathematics, sciences, and physical conditioning, which the Navy has always advocated, it is desirable to introduce preflight aeronautics courses in the secondary school curriculum or as extra curriculum.

In similar vein is the following quotation from a letter of the same date written by Hon. Robert A. Lovett, Assistant Secretary of War for Air:

> The advantage of introducing preflight aeronautics courses to supplement the basic subjects in the secondary school curriculum, where this can appropriately be done, is now becoming apparent. Those high schools which have the facilities and the requisite number of students can materially assist our war effort by emphasizing the fundamental courses of mathematics, physics, chemistry, etc., and by giving those students who are interested an opportunity to put these generally required subjects to use in elective preflight aeronautics courses.

Numerous individual secondary school teachers and school administrators who have had experience with offering courses in aeronautics and aviation education generally over the years have supplied materials and courses of study. Special recognition is due the Civil Aeronautics Administration and two of the projects financed by the C. A. A., namely, the Aviation Education Research Project of cooperating schools in the New York City area, and the aviation workshop of the University of Nebraska. The public schools of the District of Columbia also loaned valuable materials at a time when the reports were in the developmental stage.

The publication presented herewith has been prepared by Carl A. Jessen, Senior Specialist in Secondary Education Harry A. Jager, Chief, and Franklin R. Zeran, Specialist in Occupational Information, of the Occupational Information and Guidance Service, Vocational Division; Rall I. Grigsby, Consultant in Curriculum Problems, and Willis C. Brown, Consultant in Aviation Education, Vocational Division. Appendixes A and B were prepared, respectively, by Lt. Gordon Studebaker of the U. S. Army Air Forces, and Lt. Comdr. H. B. Miller of the U. S. Navy, Bureau of Aeronautics.

A reviewing committee for the publication as a whole has given invaluable assistance. The members of this committee read the manuscript and met on June 2, 1942, to pool their suggestions for its improvement. The members of this committee are:

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Col. G. L. Davasher, War Department, Washington, D. C.
Lt. Col. S. J. Donovan, War Department, Washington, D. C.
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John W. Studebaker

U. S. Commissioner of Education

PRE-FLIGHT AERONAUTICS IN SECONDARY SCHOOLS

An Administrative and Instructional Guide

PART I. ORGANIZATION AND ADMINISTRATION OF PRE-FLIGHT AERONAUTICS COURSES

Need for Aeronautics Courses

The tremendous importance of aircraft in modern warfare admits of no doubt or controversy. Control of the air has been of demonstrated advantage to the winner in every major operation both at sea and on land in the present war. Taking a lesson from the tragic happenings in Europe, the United States during the summer of 1940 set about building up its air strength. With military planes of all kinds coming off assembly lines in American factories we are now bringing about that superiority in air equipment which will be a principal factor in winning the war.

Equipment alone will, however, not achieve success. Men must be trained to fly the planes and more men made ready to keep them flying. Extensive training programs for the development of competent flight and ground personnel have been established by the Army and Navy. In this undertaking, as in the manufacture of planes, the schools have an important auxiliary function to perform and are eager to play their part.

How the Schools May Contribute

How may the schools best contribute to the training of aviation personnel? It is realized that no matter how well the schools do their job, the Army and Navy will have to put their flight and ground crews through a rigorous program of specialized training. The significance of preparation given in the schools is that if the armed forces are relieved of doing some of the elementary phases of training or if the period of such training can be shortened, the Army and Navy can concentrate more of their attention upon development of the more specialized knowledges and skills so necessary to competency in military aviation. Thousands of lives may depend upon the promptness with which the contribution is made by the schools.

The schools can contribute to the training of air force personnel in two important regards:

1. The secondary schools can give *basic training* through the regularly offered subjects. Especially important are training in mathematics, physics, and physical fitness.
2. The secondary schools can offer *specialized courses* dealing more directly with particular phases of aviation.

Basic Training

The Army and the Navy have both emphasized the importance of celerity and accuracy in fundamental operations in mathematics on the part of officers and enlisted personnel whatever their duties may be in modern warfare. For those who are to fly military planes facility in mathematical operations is especially significant as is evidenced by the fact that the Army and the Navy in the initial training periods give refresher courses in mathematics to their aviation cadets.[1]

Similarly the air forces of both Army and Navy require their aviation cadets to have a working knowledge of physics. Here the problem is complicated since many of the young men coming to them as aviation cadets have not had courses in physics. The physics courses for aviation cadets are outlined in Leaflet No. 62 to which reference has been made in footnote 1.[2] Leaflet No. 62 suggested intensive short courses for the summer session of 1942. While some schools may wish to give such intensive review courses during the coming school year, many schools may prefer to introduce aviation applications, problems, experiments, and activities into existing courses in mathematics and physics. This is but another way of saying that just as physics courses, for instance, have within the past quarter of a century been greatly influenced by the physics of the automobile, so the physics courses may appropriately now be influenced by the growing importance of the airplane.

Physical fitness always has been emphasized by the armed forces. It is particularly significant for those who are to fly military planes since special physical requirements have to be met by the flying personnel.[3]

Other subjects, commonly taught in secondary schools, can contribute in varying degree to the development of effective soldiers and sailors. English, geography and the social sciences, biology and chemistry, industrial arts and vocational subjects—these and others can provide knowledges and skills useful in the armed forces.[4] The growing importance of the airplane in modern life, and just now in modern warfare, supports the view that a modern curriculum must be sensitive to the social, economic, industrial and political changes brought about by the general adoption of this rapid mode of transportation.

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[1] The Army's manual entitled *Mathematics for Pilot Trainees* (TM 1-900) has been printed and is available from the Superintendent of Documents, Washington, D. C., at 10 cents a copy. Both the Army and Navy courses in mathematics are described in some detail in Leaflet No. 62, *Pre-Aviation-Cadet Training in High Schools* which was sent to secondary schools, public and private, by the U. S. Office of Education in May 1942.

[2] The Army manual *Elementary Physics for Pilot Trainees* (TM 1-233) is available from the Superintendent of Documents, Washington, D. C., at 20 cents a copy.

[3] For the most important of these physical requirements *see* Leaflet No. 62; this publication also contains a section on activities designed to develop that physical well-being without which no one can be accepted for military flying.

[4] See *The Best Kind of High-School Training for Military Service.* Education for Victory, U. S. Office of Education, Washington D. C. Issue of April 15, 1942.

Specialized Training

Two types of specialized training related to wartime aviation are urgently needed:

1. Courses of a vocational-technical nature designed to train for the manufacture and maintenance of military aircraft. Information concerning such vocational-technical courses may be secured by addressing the U. S. Office of Education, Vocational Division.
2. Elective courses in pre-flight aeronautics offered to pupils in the junior and senior years of high school and to out-of-school youth who are approaching or have passed the age of 18—the age at which they can be accepted for aviation-cadet training by the Army and Navy. The present publication deals primarily with such courses.

Extent of the Specialized Course Offering

Some large schools, well equipped with shops, apparatus, and trained personnel for teaching and guidance, can offer numerous specialized courses in both of the above-mentioned categories. Theirs can be a program of aviation education to include instruction in such areas as aircraft sheet metal work, engine maintenance and repair, propellers, carburetion, electrical system, aircraft drawing and blueprint reading, aircraft instruments, radio, meteorology, air navigation, and numerous other subjects related to the manufacture, servicing, maintenance, repair, and flight of airplanes. A few schools have developed comprehensive long-range curriculums involving 3-year or 4-year sequences of subjects to be taken by pupils who wish to specialize in aviation. Certainly nothing written in these pages should be construed as discouraging such schools in offering various specialized courses and in distributing their pupils to those courses according to the best procedures of guidance available to them.

The majority of secondary schools, both large and small, cannot be expected suddenly to establish comprehensive programs in aviation education of the kind mentioned above. It is believed that many may find it possible to offer 1-year or 2-year elective courses in pre-flight aeronautics. Such courses are outlined in part III of this publication.

The pressing need of the Army and the Navy for flight personnel suggests that by doubling the time allotment the first-year course in aeronautics can be completed in 1 semester, each pupil under this plan giving approximately half of his time to the subject. Such a plan is especially appropriate where many of those registering for the course are near or over 18 years of age or are within 1 semester of graduation from high school. There appears to be no good reason

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for accelerating the aeronautics courses of those who are destined to remain in school for more than a year before they will be eligible for Army or Navy training.

The Pupil's Program

The guidance and selection of pupils considering pre-flight aeronautics courses are discussed in part II of this publication. It may be appropriate at this point to consider the daily programs of such pupils.

The paramount importance of mathematics and physics supports the suggestion that pupils desiring to become aviation cadets should take as much mathematics as possible, and if they have not previously had physics they should take that subject concurrently with the aeronautics course. The stress laid upon physical fitness dictates that remediable defects be corrected and that a vigorous physical training program be introduced to precondition them for military aviation. The remainder of their programs may be made up from English, social studies, industrial arts, and other subject areas offered in the secondary school.

The following daily pupil programs are submitted for consideration:

1. Pupil having only 1 semester left before graduation, or out-of-school youth returning for training in aeronautics.

Subject	*Daily time allotment for 1 semester*
Aeronautics (first and second semester units.)	2 periods.
Review of mathematics	1 period.
Mechanics of physics	Do.
Physical fitness	1–1½ hours.

2. Pupil having 2 semesters left before graduation.

First semester

Subject	*Time allotment*
Aeronautics (first semester units)	1 period daily.
Mathematics	Regular time assignment.
Physics*	Do.
Required or elective subject	Do.
Physical fitness	1–1½ hours daily.

Second semester

Aeronautics (second semester units)	1 period daily.
Mathematics	Regular time assignment.
Physics*	Do.
Required or elective subject	Do.
Physical fitness	1–1½ hours daily.

* If not previously taken. If physics has been studied, substitute an elective subject.

OR

First semester

Subject	*Time allotment*
Aeronautics (First and second semester units).	2 periods daily.
Mathematics	Regular time assignment.
Physics*	Do.
Physical fitness	1–1½ hours daily.

Second semester

Aeronautics (Third and fourth semester units).	2 periods daily.
Mathematics	Regular time assignment.
Physics*	Do.
Physical fitness	1–1½ hours daily.

3. Pupil having 2 years left before graduation.

First semester

Subject	*Time allotment*
Aeronautics (First semester units)	1 period daily.
Mathematics	Regular time assignment.
Physics	Do.
Required or elective subject	Do.
Physical fitness	1–1½ hours daily.

Second semester

Aeronautics (Second semester units)	1 period daily.
Mathematics or elective subject	Regular time assignment.
Required or elective subject	Do.
Required or elective subject	Do.
Physical fitness	1–1½ hours daily.

Third semester

Aeronautics (Third semester units)	1 period daily.
Mathematics or elective subject	Regular time assignment.
Required or elective subject	Do.
Required or elective subject	Do.
Physical fitness	1–1½ hours daily.

Fourth semester

Aeronautics (Fourth semester units)	1 period daily.
Mathematics or elective subject	Regular time assignment.
Required or elective subject	Do.
Required or elective subject	Do.
Physical fitness	1–1½ hours daily.

*If not previously taken. If physics has been studied, substitute an elective subject.

The Teacher Problem

Since for the most part pupils will pursue regularly offered courses in mathematics and physics no special problem is presented in the type of training needed by teachers in these subjects; mathematics and science teachers generally are competent to make the needed adaptations once they know what those content adaptations are.[5]

However, in the *number* of teachers needed in mathematics, science, and physical fitness a critical problem may be encountered. If large numbers of pupils survive the selection procedures for the pre-flight training course, junior and senior classes in mathematics, science, and physical fitness may require more teachers than are available in these subjects at the present time. The sum total of pupil-hours of instruction in the schools as a whole will probably not be greatly increased since a pupil who elects to take mathematics or physics presumably decides to omit some other subject which he might otherwise select; but the shift in any considerable number of pupil programs necessitates a corresponding shift in teacher schedules.

The most crucial problem is likely to come in securing teachers qualified to take charge of the classes in pre-flight aeronautics. Relatively few teachers with special training are available for this assignment.

Three general solutions for anticipated teacher shortages present themselves. In the first place, teachers with minors in mathematics, science, and physical education may be shifted to teaching duties in these subjects. Then, there are in most communities former teachers who can be induced to come back into the classroom at least on a part-time basis. The third source of supply is teacher-training institutions which, through the year and more particularly during the summer, provide training for teachers of mathematics, physics, physical education, aviation, and related subjects. The U. S. Office of Education has prepared and circulated a directory of institutions offering such courses during the 1942 summer session. Significant in this connection is the recent ruling that the 650 colleges and universities offering Civil Aeronautics Administration C. P. T. (civilian pilot training) courses this summer may admit, tuition-free, teachers who are planning to teach pre-flight aeronautics or other aviation courses in secondary schools next fall.

Provisions Supplementary to Day-School Classes

Although it may be expected that the largest number to be served by secondary school courses in pre-flight aeronautics will be pupils enrolled in regular day school, it by no means follows that the prospects for such training should be limited to this group.

Some of the possibilities of *summer-school courses* of pre-aviation

[5] See Leaflet No. 62 to which reference has previously been made.

character have been described in Leaflet No. 62 to which reference has already been made. If, in addition to the recommended short courses in mathematics, physics, and physical fitness, more specialized work in aeronautics can be offered, so much the better.

Many of those who have dropped out or have graduated from high school in recent years will be interested in *evening classes* in aeronautics. Evening classes are especially significant because they reach the out-of-school group of ages 18 to 26 that are not in college. This is an important source of potential aviation cadets for immediate training. One large city reports that the evening schools are training men in aviation at the rate of about 1,200 per year; a total of 600 former evening-school enrollees from this city are in aviation-cadet training. The courses offered can be similar to those given in day school. For most of these older pupils it will be desirable to provide reviews in mathematics and physics.

Self-teaching materials are another means which can be used successfully with this older group and with day-school pupils in both large and small schools. Correspondence lessons are available in aviation, aeronautical engineering, airplane design and construction, airplane engines, airplane maintenance, blueprint reading in airplane work, meteorology, model building, and radio. Moreover, some textbooks are developed on the principle of supplying much direction to the student, thus reducing the need for constant teacher supervision. The use of self-teaching materials is especially desirable in small schools where the group selected for study of pre-flight aeronautics is too small for an organized class. Pupils with an enterprising motive can achieve marked success if they are provided with the material involved, given special privileges enabling them to work by themselves, and supplied individual out-of-class assistance by teachers. Such pupils are competent to do much work "on their own" if they are given occasional direction and encouragement.

The need is urgent; let each school and each teacher contribute as much as possible.

PART II. GUIDANCE AND SELECTION OF YOUTH FOR ENROLLMENT IN PRE-FLIGHT AERONAUTICS

Focusing the Guidance Program

The outcome of that part of the school's guidance program in which this publication is interested is a supply of students who will enter upon a pre-flight aeronautics course, meet its demands, and later qualify as aviation cadets with relatively few failures.

In schools where the guidance program has already given some attention to aviation occupations, and in others where there is less experience in guidance procedures, one or two cautions may be serviceable in distinguishing pre-flight aeronautics from other types of aviation training.

1. The course described in this publication is primarily for the preliminary training of candidates for military *flight* officer occupations. Confusion with military *ground-crew* officer occupations must be avoided, since the latter require 2 or 3 years of college training of an engineering nature. Such occupations are not in an area in which the secondary school can offer training immediately preliminary to military service.

2. A second cause of confusion is those military ground-crew occupations on a noncommissioned or enlisted man basis. Such occupations call for characteristics necessary for a mechanic who services planes and their equipment. Neither the Army nor the Navy would be greatly assisted in securing such workers through a pre-flight aeronautics course in secondary schools. The Army at present obtains such ground-crew men either from the ranks of Selective Service, which the present age requirement removes from the immediate area of secondary schools; or from those men who had begun officer flight training as aviation cadets but were unable to complete all the requirements for a commission. The Navy, on the other hand, selects its ground-crew mechanics from enlisted men found to be qualified according to its own standards. The Navy assigns enlisted men to special occupations only after a period of preliminary training and entirely at the option of the training officer.

Finally, two other cautions may be given: First, the process of guidance and selection suggested is not intended to discourage unduly the enrollment in pre-flight aeronautics classes of any interested persons except those with characteristics which would surely prevent their success in the course or make them ineligible for aviation cadet training. The course outlined in part III is not without general value as a course in applied science, even though designed primarily for the preliminary training of prospective aviation cadets. Moreover, since the present physical and other requirements for airplane

pilots, both military and civilian, are subject to future change, too restrictive a policy might exclude from the pre-flight aeronautics course many potentially valuable flyers.[1] Second, the selection for and completion of the pre-flight aeronautics course recommended in this publication cannot be interpreted as a guarantee that the candidate will be accepted by the Army or Navy as an aviation cadet. The Army and Navy, of course, retain final authority in this matter.

The School Counselor

The school will need one or more persons, according to numbers involved, able to act as individual counselors and to take responsibility for carrying on other aspects of guidance and selection. If the school already has a person designated for such duties, he or someone responsible to him is the most suitable choice, provided he takes the necessary steps to become familiar with all peculiar problems involved in guidance and selection directed at securing a supply of pre-flight aeronautical candidates. This counselor would have general charge of each aspect of the program described hereafter.

Presenting Preliminary Information

Presenting information to the student body concerning the needs of the Armed Services for aviation personnel and concerning the proposed course in pre-flight aeronautics challenges the ingenuity of the individual school. In general, schools will employ some or all of the following means: Posters, leaflets, and literature supplied by the Army and Navy Recruiting Offices; bulletin boards, school bulletins, school assemblies, and materials for study in classes in occupations or in social studies.

In the Appendix are brief accounts of what happens to a boy once he has been accepted for Army or Navy flight training. Several references designed to give an overview of military and naval aviation will be found under Unit I in the outline in Part III hereof. In addition, the following sources of information concerning military aeronautics should be consulted:

1. For the Army—

In addition to literature available at local Army Recruiting Stations (consult your Postmaster or Chief State School Officer for the location of the nearest Army Recruiting Station).

(1) *Army Air Forces chart*—prepared by the U. S. Office of Education and the U. S. Army Air Forces (available from the U. S. Office of Education).

(2) *Aviation cadets*—prepared under the direction of the Adjutant General, dated March 1, 1942. 21 pages. (Available from Army Recruiting Stations.)

[1] Write the Civil Aeronautics Administration, Department of Commerce, Washington, D. C., for details of its newly announced program to train large numbers of flying specialists for the Army and Navy, including instructors, glider pilots, airline co-pilots, and liaison and service pilots. This training will be available to men, age 18-36, inclusive, who pass the C. A. A. mental and physical tests but who are unable to pass the requirements of the Army for combat Flying Cadets.

(3) *Revised U. S. Army Air Force Aviation Cadet Program, Including New Enlisted Reserve Plan*—prepared for institutions of higher learning, secondary schools and the U. S. Army Recruiting and Induction Stations. Effective April 4, 1942. (Available from Army Recruiting Stations.)

2. For the Navy—

In addition to literature available from local Navy Recruiting Stations (consult your Postmaster or Chief State School Officer for the location of the nearest Navy Recruiting Station).

(1) *Navy aviation chart*—prepared by the U. S. Office of Education and the Bureau of Aeronautics of the Navy Department (available from the U. S. Office of Education).

(2) *Navy educational program chart*—March 1942 (available from the Navy Recruiting Stations).

(3) *Navy wings—Aviation flight training for the U. S. Navy and Marine Corps*—prepared by the Navy Department. 20 pages. 1941. (Available from Navy Recruiting Stations.)

Student Records

The interest aroused among potential candidates for a pre-flight course will result in many individuals seeking out the counselor for information as to whether they are personally able to qualify for the course offered. The counselor should, preliminary to such interviews, study school records of the counselees. Details necessary to the study include the following, and, if these are not available, measures must be taken to add this information to the data already at hand:

1. Physical fitness.
2. Age.
3. Accomplishment in mathematics, science, or shop courses.
4. Mental alertness or scholastic aptitude.
5. Hobbies, part-time work experience, or other evidence of aeronautical interest.

Applying Selection Criteria

Individual interviews with counselees may result in the elimination of some candidates whose general characteristics obviously unfit them for the pre-flight aeronautics course.

The Navy requirements[2] are listed in the *Manual of the Medical Department,* Section XXIII. While the stipulations cannot be summarized in this brief statement the following can be mentioned as basic requirements, failure in any one of which will be cause for rejection on physical grounds:

Normal vision 20/20 each eye, unaided by glasses.
Normal hearing.
Normal color vision.
Minimum height requirements, 64 inches; maximum height requirements, 76 inches.

[2] These and other qualifications are described in *Pre-aviation Cadet Training in High Schools,* Leaflet No. 62, U. S. Office of Education.

Minimum weight requirements, 124 pounds; maximum weight requirements, 200 pounds.
Minimum blood pressure, systolic 105; maximum, systolic 135.
No history of asthma or hay fever.
Freedom from rupture or evidence of abnormal relaxed rings, conducive to rupture.
Minimum of 18 sound teeth, 2 of which shall be opposing molars.

The recruiting manual for aviation cadets in the U. S. Army gives the following requirements:

Visual acuity 20/20 bilateral.
Normal color vision.
Unimpaired ocular muscle balance.
Unimpaired optical organism, anatomically and mechanically.
Good respiratory ventilation and vital capacity.
Hearing 20/20 each ear.
A stable equilibrium.
A sound cardiovascular system, nervous and organic.
A well-formed, well-adjusted, and coordinated physique.
Height: minimum, 60 inches; maximum, 76 inches.
An integrated and stable central nervous system.
A minimum of 12 teeth, 3 pairs each of serviceable, natural, opposing incisors and masticating teeth.

A physical examination is a desirable part of the selection procedure. Many schools will be able to use the services of regular school physicians. In other cases local physicians may be willing for patriotic reasons to volunteer the necessary services. The military authorities will always exercise their right to a final physical examination, but the school physical examination will have two desirable results: First, the revelation of defects which may be remedied; and, second, the elimination of candidates for whom later flight training would be out of the question for physical reasons.

The Army and Navy will apply at the time of enlistment certain mental tests of their own. However, the school may determine with considerable success whether a candidate has the requisite mental characteristics by applying to candidates the procedures suggested in the pamphlet *Engineers are Needed* [3] a copy of which was sent to every secondary school in the country from the U. S. Office of Education in April 1942. The items on pages 10 to 14 of this pamphlet may be adapted for use in relation to pre-flight aeronautics candidates, since the mental characteristics suited to the study of engineering are not unlike those required in the pre-flight aeronautics course.

Summary

To sum up, the guidance and selection program should have the following characteristics:

The provision of ample sources of information for general

[3] Available free. Occupational Information and Guidance Service, U. S. Office of Education, Washington, D. C.

orientation purposes for all those potentially interested in preflight aeronautical training.

The availability of a counselor or a person specially designated, for personal interviews for those individuals who would profit by such counseling. This person should have, or acquire, considerable background, with a broad view of desirable outcomes for counselees.

Preliminary records on all pupils, sufficiently comprehensive to enable the counselor to conduct initial individual interviews intelligently.

Means of securing further data on candidates interested in specific training objectives so that their characteristics in relation to these objectives may be studied with some accuracy.

Knowledge by the counselor of the qualifications demanded in the special military aeronautical training for which the school is offering preparation so that the candidate and the counselor may jointly match the candidate's characteristics with the job requirements.

Means of applying selection procedures, including the services of a physician when necessary.

PART III. RECOMMENDED OUTLINE FOR A PRE-FLIGHT AERONAUTICS COURSE

General Introductory Statement

The outline of subject matter which is presented in the following pages includes only such teaching units as are calculated to be of definite usefulness in the preliminary preparation of flying personnel for the armed forces. The outline is intended to be broadly definitive of the field of pre-flight aeronautics for prospective aviation cadets rather than narrowly prescriptive of the particular topics to be studied.

In general, the 11 units, providing material for 4 semesters' work, have been arranged in sequential teaching order. The units are also arranged in an order of priority as to their value for pre-aviation cadet training. That is to say, Army and Navy aviation officials have expressed the judgment that if only 1 semester's work of 90 hours can be given in any school, units 1–4, inclusive, are of greatest probable value. If 2 semesters' work can be offered, units 5–7, inclusive, should be added; and similarly for semesters 3 and 4 as shown in the chart, *Summary of Recommended Units*.

Adjustment to Meet Local Conditions

The 360-hour course in pre-flight aeronautics, as summarized in the aforementioned chart and as outlined in the ensuing pages, can be adjusted to meet specific conditions of secondary schools, whether large or small, public or private, in various parts of the country. Thus, by devoting 10 periods per week throughout 2 semesters a particular group of students should be able to cover all of the units outlined. Similarly, by devoting 10 periods per week throughout 1 semester, the first 7 units can be covered. Again, if tests disclose the need therefor with any particular group of students, a refresher course in essential mathematics and physics (as outlined in U. S. Office of Education Leaflet No. 62) can precede the pre-flight aeronautics course, in which case the fourth semester's unit in communications would be omitted.

Some schools may wish to offer only certain selected units of the course outlined. In that case the arrangement of the units in order of priority should be borne in mind. In some schools enthusiastic teachers and students may wish to cover a number of units in a course meeting after school hours. Again, classes organized for out-of-school youth to meet in the late afternoon or evening can be scheduled to cover any number of units depending upon the amount of time available.

Selected References

The selected references listed under each of the teaching units outlined have been brought together in a Summary Chart of Selected

References. A study of that chart will indicate which of the books have the widest utility in connection with the units outlined and which are limited in their scope to one or two units only. It is not meant to imply that the references listed are necessarily the only textbooks of any value for use in connection with the study of a given unit. The field of aeronautics is growing and changing with such rapidity that textbooks frequently need to be revised. Several publishers now have in process of publication new or revised editions of textbooks appropriate for use in secondary school courses in aeronautics which should be available by September 1942. The titles listed merely represent a consensus of judgments of various teachers, aviation officials, and other qualified persons concerning some of the books now available whose accuracy, scope, recency of publication, and teachability recommend their examination by school officials.

Teaching Aids

Under each unit have also been listed some suggestions as to visual aids and equipment which are deemed valuable for the teaching of particular units. The visual aids have been keyed by number to the General Source List of Visual Aids. No attempt has been made to list all items of useful equipment frequently found in high-school physics laboratories, such as psychrometers, barometers, Boyle's Law tubes, etc. It should be noted that the principles of aeronautics can often be demonstrated with familiar and easily secured tools, machines, or apparatus which may be found in the school shops or secured from interested citizens.

A start only has been made in listing visual aids. Diagrams, pictures, charts, graphs, and maps can be secured by teachers and students from a variety of sources and brought together to illustrate various units of the courses.

Because of limitations of space, no effort has been made to suggest for each unit the wide variety of student activities which might be employed in the development of an understanding of aeronautical principles—activities involving writing reports; drawing graphs, pictures, diagrams; observing planes in flight; constructing model planes and items of laboratory equipment; collecting pictures, news stories, and other scrapbook materials; demonstrating the use of instruments, maps, charts. A number of the references listed suggest class activities. Other such activities will suggest themselves to the alert teacher.

Summary of Recommended Units in a Pre-flight Aeronautics Course With Tentative Time Allotments

First semester

	Periods
Unit 1. Orientation—overview of military aviation	5
Unit 2. Aircraft structures and identification of military aircraft	20
Unit 3. Aerodynamics	30
Unit 4. Power plants	35

Second semester

Unit 5. Communications I	20
Unit 6. Meteorology I	30
Unit 7. Avigation I	40
Total	180

Third semester

Unit 8. Gliding	20
Unit 9. Meteorology II	30
Unit 10. Avigation II	40

Fourth semester

Unit 11. Communications II	
(*a*) Advanced radio	40
(*b*) Radio code practice	50
Total	180

UNIT I. ORIENTATION: OVERVIEW OF DEVELOPMENT OF AVIATION AND OUR AIR FORCES

Introductory

The purpose of this unit is to provide an overview of the scope of the course and to afford the instructor an opportunity to become acquainted with the members of the class. In this brief unit pupils are introduced to some of the important personalities in aviation history and are given a general overview of modern military aviation.

Outline of Topics

A. Men who made aviation history:
1. Daedalus and Icarus.
2. da Vinci, Leonardo.
3. Montgolfier Brothers.
4. Charles, J. A. C.
5. Lilienthal, Otto.
6. Chanute, Octave.
7. Langley, Samuel P.
8. Wright Brothers, Orville and Wilbur.
9. Farman, Henri.
10. Bleriot, Louis.
11. Curtiss, Glenn.

12. Martin, Glenn.
13. Douglas, Donald.
14. Rickenbacker, Edward.
15. Sperry, Laurence B.
16. Lindbergh, Charles A.
17. Earhart, Amelia.
18. Zeppelin, Count von.

B. Records:
1. Lighter than air.
2. Heavier than air.
(a) Speed.
(b) Distance.
(c) Altitude.
(d) Duration.
(e) Weight.

C. The Army air forces:
1. Organization.
2. Enlisted men.
3. Officers and flying cadets.
4. Training and materials.

D. The Navy air forces:
1. Organization.
2. Enlisted men.
3. Officers and flying cadets.
4. Training and materials.
5. Bureau of Aeronautics.
6. Aircraft carriers.
7. Lighter-than-air-craft.

E. Marine aviation.

F. Coast Guard aviation.

G. Civil Aeronautics Administration.

H. Civil Air Patrol.

Some Selected References

Aviation From the Ground Up. G. B. Manly. 1942. Drake & Co.

Aviation Pre-flight Training for High Schools. Hamburg and Tweney. 1942. Pitman.

Any modern encyclopedia.

Famous American Fliers. Chelsea Fraser. 1941. Thomas Crowell Co.

Flight, First Principles. Wright Smiley Martin. 1941. American Technical Society.

Horizons Unlimited. S. Paul Johnston. 1941. Duell, Sloan, & Pearce.

Navy Wings. H. B. Miller. 1942. Dodd, Mead.

The Story of Flying. Archibald Black. 1940. McGraw-Hill.

The Flying Game. H. H. Arnold. 1938. Funk & Wagnalls Co.

What the Citizen Should Know About the Army. H. S. Ford. 1942. Norton & Co.

What the Citizen Should Know About the Air Force. Harold E. Hartney. 1942. Norton & Co.

Win Your Wings. Vol. 1. R. Turner and Jean H. Dubuque. 1940. Drake & Co.

Wings of Defense. Burr W. Leyson. 1942. Dutton & Co.

Some Teaching Aids [1]

Men and Wings (19).
History of Aviation (17).
The Air Fleet (16).
Historical (29).
The Airacobra (3).
Famous Flights and Fliers (29).
Test Methods of NACA (23).
Story of Aviation (8).
Sailors with Wings (21).
Wings of the Army (31).
Wings of Gold and Eyes of the Navy (34).

UNIT II. AIRCRAFT STRUCTURES AND IDENTIFICATION OF MILITARY AIRCRAFT

Introductory

This unit begins with an analysis of the various types of planes and their component parts, in the course of which pupils should become familiar with the proper nomenclature of the airplane. The unit will acquaint pupils with the materials used in the construction of aircraft and will give an understanding of how planes are fabricated, tested, and inspected. In studying identification of aircraft, the training should tend toward recognition of the whole plane by its silhouette, rather than an analysis of minute details. Scale models should be used in demonstration, and silhouette wall charts provided.

Outline of Topics

A. Analysis of planes:
   1. Types of planes—
      (a) By landing gear.
      (b) By number of wings and position.
      (c) By number of engines and position.
      (d) Autogiro.
      (e) Helicopter.
      (f) Ornithopter.
   2. Parts of a typical plane—
      (a) Fuselage.
      (b) Wings.
      (c) Power plant.
      (d) Empennage.

B. Recognition of planes from silhouette outline:
   1. Number of engines; radial, in line, placement.
   2. Monoplane or biplane.
   3. Tractor or pusher.
   4. Shape of wings and placement:
      (a) Straight.
      (b) Elliptical.
      (c) Balanced taper.
      (d) Sweepback.

[1] Numbers refer to sources listed under section entitled *General Source List of Visual Aids.*

(e) Trailing edge taper.
(f) Parallel center section taper tips.
(g) Gull.

5. Elevator shape.
6. Rudder shape and number.
7. Fuselage distinguishing points.

C. Aircraft materials:

1. Fabrics.
2. Woods.
3. Metals and alloys.
4. Plastics.

D. Structures of aircraft:

1. Fuselage.
2. Wings.
3. Landing gear.
4. Empennage.

E. Joining, fastening, and safetying:

1. Wood.
2. Metal.
3. Plastic.

F. Testing and inspecting:

1. Factory.
2. Maintenance.
3. Safety.

Some Selected References

ABC of Aviation. Victor W. Page. 1941. Henley.

Aircraft Spotters Guide. H. E. Hartney. National Aeronautics Council, Inc.

Aircraft Maintenance. D. J. Brimm and H. E. Boggess. 1941. Pitman.

Air Pilot Training. Bert Shields. 1942. McGraw-Hill.

Aviation Dictionary. Harold E. Baughman. 1940. Aero Publishing Co.

Aviation From the Ground Up. G. B. Manly. 1940. Drake & Co.

Aviation Pre-flight Training for High Schools. Hamburg and Tweney. 1942. Pitman.

C. A. A. Civilian Pilot Training. Bulletin No. 27 C. A. A. 1940. United States Government Printing Office.

Elements of Aeronautics. Pope and Otis. 1941. World Book Co.

Flight—Construction and Maintenance. 1941. American Technical Society.

Horizons Unlimited. S. Paul Johnston. 1941. Duell, Sloan, and Pearce.

Safety in Flight. Assen Jordanoff. 1941. Funk & Wagnalls Co.

The Aircraft Spotter. Lester Ott. 1941. Harcourt.

The Aircraft Yearbook. Howard Mingos. 1942. Aero Chamber of Commerce.

The Aviation Mechanics. Norcross and Quinn. 1941. Whittlesey House.

What's That Plane: Friend or Foe? Walter B. Pitkin, Jr. 1942. Penquin Publishing Co.

Win Your Wings, Vol. II. Turner and Dubuque. 1940. Drake & Co.

Some Teaching Aids [1]

Plane Performance (19).

Autogiro (17) (29).

[1] Numbers refer to sources listed under section entitled *General Source List of Visual Aids.*

Airplane Welding (17).
Lighter than Air (29).
Riveting (30).
Land Planes (29).
Jigs and Fixtures (30).
Sea Planes (29).
Methods of Fabrication (30).
The building of PBY's (10).
Methods of Assembly (30).
Building a Bomber (25).
Heat Treatment of Aluminum Alloys (30).
Look to Lockheed for Leadership (20).
The Component Parts of an Airplane (30).
Identification of Aircraft (9).
Construction (29).
Essential parts and types of planes (7).
Maintenance (29).
Curtiss-Wright answers the call for quantity (4).
Aviation (5).
Airplane structures (35):

1–211	1–212
1–213	1–214
1–215	1–312
1–223	1–246

Messerschmitt —11— (37).
Color slides— (38).
Aircraft structure charts (26):
Chart 1. Parts of Airplane (22).
Chart 2. Silhouettes (22).
Panel to be made up for class display showing effect of five forces on actual material.
Photographs illustrating manufacturing processes.
A full-sized rib of an airplane made of wood or metal.

UNIT III. AERODYNAMICS

Introductory

The purpose of this basic unit is to acquaint the pupils with the various physical laws which govern flight, also their application to the several theories of flight and to the control of a plane in flight. Stresses and strains on various parts of the aircraft should be studied, and problems solved. The designing, building, and test flying of aircraft models provides a valuable activity for demonstrating the applications of principles outlined for study in this unit.

Outline of Topics

A. Theory of flight:
1. Newton's laws.
Applications to aviation of first, second, and third laws.
2. Bernouilli's Principle.
Applications to aviation.
3. Pradtl's studies in turbulence.

467837°—42——4

B. Four forces acting on a plane:
   1. Lift (vector diagram).
   2. Drag.
   3. Gravity.
   4. Thrust.

C. Three axes of stability:
   1. Lateral.
   2. Longitudinal.
   3. Normal.

D. Control surfaces:
   1. Primary control surfaces:
      (a). Ailerons.
      (b) Rudder
      (c) Elevator.

E. Balance and stability:
   1. Static stability.
   2. Dynamic stability.

F. Secondary control surfaces:
   1. Flight control.
   2. Stabilizing surfaces.

G. Forces developed by propeller:
   1. Torque.
   2. Thrust.

H. Stress and strain on aircraft:
   1. Definitions and examples.
      (a) Tension.
      (b) Compression.
      (c) Bending.
      (d) Shearing.
      (e) Torsion.
   2. Safety factor.

Some Selected References

ABC of Aviation. V. W. Page. 1941. Henley.

Aerodynamics for Model Aircraft. Avrum Zier. 1942. Dodd, Mead.

Air Pilot Training. Bert Shields. 1942. McGraw-Hill.

Airplane Models and Aviation. Willis C. Brown. 1942. D. C. Heath & Co.

Aviation From the Ground Up. G. B. Manly. 1940. Drake & Co.

Aviation Pre-Flight Training for High Schools. Hamburg and Tweney. 1942. Pitman.

C. A. A. Civilian Pilot Training, Bulletins No. 23, 26. C. A. A. 1940. United States Government Printing Office.

Elements of Aeronautics. Pope and Otis. 1941. World Book Co.

Flight, First Principles. Wright, Smiley, and Martin. 1941. American Technical Society.

Horizons Unlimited. S. Paul Johnston. 1941. Duell, Sloan, and Pearce.

Model Airplane Design. Charles H. Grant. 1942. Jay Publishing Co.

Principles of Flight. Bert Shields. 1942. McGraw-Hill.

Simplified Theory of Flight. Gillmer and Nietsch. 1941. Van Nostrand.

The Aviation Mechanic. Norcross and Quinn. 1941. Whittlesey House.

The Model Aircraft Handbook. William Winter. 1941. Thomas Crowell.

Win Your Wings Vol. 1. Roscoe Turner and Jean Dubuque. 1940. Drake & Co.

Your Wings. Assen Jordanoff. 1940. Funk & Wagnalls Co.

Some Teaching Aids [1]

Lift and Drag (19).
Wing Forces (19).
Stability (19).
Smoke Streams (15).
Principles of Flight (12).
Theory of Flight (13).
Conquests in the Air (14).
Aerodynamics—3 parts (4).
Youth Takes to Wings (7).
Aerodynamics 1–160, 1–161. (35)
Physics laboratory compressed air hose with jet nozzle.
Ping-pong ball.
Wall Chart "Parts of Plane" by Air Youth Division, National Aeronautics Assoc., Washington, D. C.

UNIT IV. POWER PLANTS

Introductory

In this unit, the principles of operation of the two-stroke cycle, four-stroke cycle (commonly called two-cycle and four-cycle), and diesel engines are taught; also the classification of engines, with the advantages and disadvantages of various types. Design factors involved in handling metals of different rates of expansion and advantages of water and air cooling are outlined. A functional study of carburetors, ignition systems, engine accessories, and instruments is made. Fuels and lubricants are studied in a fundamental manner. Types of propellers are discussed in connection with engines, as the engine and propeller are analyzed together as a complete power unit.

Outline of Topics

A. Function and development.
B. Size and location of power plant.
C. Principles of operation:
    1. Two-cycle engines.
    2. Four-cycle engines.
    3. Diesel engines.
D. Engine types:
    1. Vertical single row.
    2. Inverted single row.
    3. "V"–"W"–"Y".
    4. Opposed and "X".
    5. Radial.
    6. Double radial.
E. Nomenclature.
F. Design factors:
    1. Weight, horsepower, and materials.
    2. Reliability.
    3. Economy of operation.
    4. Flexibility.

[1] Numbers refer to sources listed under section entitled *General Source List of Visual Aids.*

5. Balance.
6. Modern refinements.

G. Cooling Systems:
1. Oil.
2. Engine.

H. Carburetion.
I. Fuel injection.
J. Superchargers.
K. Ignition and spark timing.
L. Fuels.
M. Lubricants.
N. Starters.
O. Engine instruments.
P. Propellers:
1. Simple design and theory.
2. Classifications:
(a) Fixed.
(b) Adjustable.
(c) Controllable.
(d) Constant speed.
(e) Feathering.

Some Selected References

ABC of Aviation. Victor W. Page. 1941. Henley.
Aircraft Engine Maintenance. Brimm and Boggess. 1939. Pitman.
Aircraft Power Plant Manual. G. B. Manly. 1942. Drake & Co.
Aviation from the Ground Up. G. B. Manly. 1942. Drake & Co.
Aviation Pre-flight Training for High Schools. Hamburg and Tweney. 1942. Pitman.
C. A. A. Civilian Pilot Training, Bulletins No. 28, 30. C. A. A. 1940. United States Government Printing Office.
Elements of Aeronautics. Pope and Otis. 1941. World Book Co.
Flight, Aviation Engines. Kuns. 1941. American Technical Society.
Model Gasoline Engines. Raymond F. Yates. 1941. Appleton-Century.
Principles of Aircraft Engines. Bert Shields. 1942. McGraw-Hill.
Safety in Flight. Assen Jordanoff. 1941. Funk & Wagnalls Co.
The Airplane and Its Engine. Chatfield, Taylor, and Ober. 1940. McGraw-Hill.
The Aviation Mechanic. Norcross and Quinn. 1941. Whittlesey House.
Through the Overcast. Assen Jordanoff. 1938. Funk & Wagnalls Co.
Win Your Wings, Vol. 2. Turner and Dubuque. 1940. Drake & Co.

Some Teaching Aids [1]

Aviation Engines (4) (6).
The Airplane Engine (19).
Fuel and Feed (19).
Airplane Ignition (19).
Engine Instruments (19).
Engines (29).
Airscrew (24).
Instruments (29).
Propellers (29).
Keep 'Em Flying (18).

[1] Numbers refer to sources listed under section entitled *General Source List of Visual Aids.*

Wright Builds for Air Supremacy (39).
Engines No. 1–135, 1–136, 1–137 (35).
Aircraft Engine Charts (26).
Fuel and oil charts (26).
Cut away cylinder of gasoline engine.
Model airplane engine for classroom operation. (*See* Model Airplane Magazine for advertisement of Model Engine Manufactures. It is suggested that a test block unit be built up on which can be mounted model engine, coil, condenser, batteries, etc.).

UNIT V. COMMUNICATIONS I

Introductory

It is not the intent of this unit to produce advanced radio technicians. A brief descriptive survey of radio circuits is presented as to their use in radio telephony and telegraphy, radio beams, and radio aids to blind landing. Teletype operation, together with the general organization of communications work on the ground and in the air, is taught from a functional point of view.

Any time remaining may be devoted to the improvement of the pupil's technique of sending and receiving audible signals in accordance with Army and Navy suggestions.

NOTE: The Army and Navy agree that if methods outlined in "Learning the Radio Telegraph Code," by the American Radio Relay League are carefully followed, good results are to be expected. However, they caution that, if it cannot be taught as above, it is better to omit code work entirely from Units V and XI, rather than risk the formation of incorrect habits. It is further suggested that contact be made with Government-licensed amateur radio operators to assist in obtaining equipment and instruction of classes.

Outline of Topics

A. Radio—function:
   1. Types of tubes and circuits:
      (a) Functions of radio tubes.
      (b) Typical radio circuits and their operation.
   2. Radio international Morse code:
      (a) How to learn code.
      (b) Code practice, receiving.
      (c) Code practice, sending.
   3. Radiophone theory:
      (a) Phone transmitters and receivers.
      (b) Dispatchers equipment.
      (c) Procedure.
   4. Radio regulations.
   5. Radio beacon (beam).

B. Teletype:
   Brief description of function.

C. Visual signals:
   1. Where used.
   2. Practice in sending and receiving.

Some Selected References

Aeronautic Radio. M. F. Eddy. 1939. Ronald Press.

Airplane Radio Equipment. E. Malloy. 1941. Chemical Publishing Co.

Aviation Pre-flight Training for High Schools. Hamburg and Tweney. 1942. Pitman.

Basic Radio. J. Barton Hoag. Appleton-Century.

Boys Book of Radio. Alfred Morgan. 1940. Appleton-Century.

C. A. A. Civilian Pilot Training, Bulletin No. 29. C. A. A. 1940. U. S. Government Printing Office.

Elements of Aeronautics. Pope and Otis. 1941. World Book Co.

Flight, Meteorology and Aircraft Instruments. Wright, Dyer, and Martin. 1941. American Technical Society.

Getting Acquainted with Radio. Alfred Morgan. Appleton-Century.

Learning the Radio Telegraph Code. A. R. R. L. 1942. American Radio Relay League, Hartford, Conn.

Safety in Flight. Assen Jordanoff. 1941. Funk & Wagnalls Co.

Through the Overcast. Assen Jordanoff. 1938. Funk & Wagnalls Co.

The Radio Amateur's Handbook (Defense Edition), A. R. R. L. 1942. American Radio Relay League, Hartford, Conn.

Understanding Radio. Watson, Welch, and Eby. 1940. McGraw-Hill.

Win Your Wings, Vol. II. Turner and Dubuque. 1940. Drake & Co.

Some Teaching Aids [1]

Radio and Control (19).

Electrons on Parade—RCA (27).

Radio and Aircraft (29).

Wizardry of Wireless (35).

Communications No. 11–1 (35).

Audio oscillator, properly wired to key and power, should be provided to teach code to the group.

The Radio Amateur's Handbook (Special Defense Edition may be procured from American Radio Relay League, West Hartford, Conn. This contains articles on how to build radio laboratory equipment as well as a great deal of theory).

UNIT VI. METEOROLOGY I

Introductory

The purpose of this unit is to give an elementary understanding of atmospheric phenomena and to show how they affect flying.

This unit concerns itself with fundamental cloud types, circulation of air, variations caused by changes of temperature and air pressure.

Safety as an integral part of flight planning should be stressed. The need is great for pilots who can, through difficult conditions, reach their objective, discharge their mission, and return. The commercial value of safety is equally important.

Outline of Topics

A. Air pressure:

1. Variations with altitude.
2. Human reactions to air density.

[1] Numbers refer to sources listed under section entitled *General Source List of Visual Aids.*

B. Movement of air masses:
   1. Rotational.
   2. Convectional.
   3. Cold fronts.
   4. Local.

C. Temperature variants:
   1. Land and sea.
   2. Polar to equatorial.

D. Moisture and precipitation:
   1. Clouds, how formed.
   2. Rain, humidity, and condensation.
   3. Snow, ice, and fog.

E. Basic cloud types:
   1. Cirrus.
   2. Stratus.
   3. Cumulus.
   4. Nimbus.

F. Gathering observations and data daily:
   1. Clouds.
   2. State of weather.
   3. Visibility.
   4. Pressure.
   5. Temperature.
   6. Humidity.
   7. Wind direction.
   8. Wind velocity.
   9. Ceiling.
   10. Precipitation.

G. Map interpretations.

H. Pre-flight considerations:
   1. Line storms, thunderstorms.
   2. Visibility.
   3. Wind, altitude in distance flying.
   4. Icing conditions.
   5. Safety in daily plans.

Some Selected References

Aerial Navigation and Meteorology. Lewis A. Yancey. 1941. Henley.

Air Navigation. P. V. H. Weems. 1938. McGraw-Hill.

Air Pilot Training. Bert Shields. 1942. McGraw-Hill.

Aviation From the Ground Up. G. B. Manly. 1940. Drake & Co.

Aviation Pre-flight Training for High Schools. Hamburg and Tweney. 1942. Pitman.

C. A. A. Civilian Pilot Training, Bulletins No. 25, 30. C. A. A. 1940. United States Government Printing Office.

Elementary Meteorology. Finch, Trewartha, Shearer, Candle. 1942. McGraw-Hill.

Elements of Aeronautics. Pope and Otis. 1941. World Book Co.

Flight, Meteorology and Aircraft Instruments. Wright, Dyer, and Martin. 1941. American Technical Society.

Safety in Flight. Assen Jordanoff. 1941. Funk & Wagnalls Co.

The Meteorological Glossary. 1940. Chemical Publishing Co.

Through the Overcast. Assen Jordanoff. 1938. Funk & Wagnalls Co.

Win Your Wings, Vol. I. Turner and Dubuque. 1940. Drake & Co.

Some Teaching Aids [1]

Cloud and Weather (2).
The Air Ocean (19).
Air Masses (19).
Weather (19).
The Weather (13), (14).
Modern Weather Theory and Structure of Storms No. 1–134 (35).
Cloud form charts (33).
Classroom thermometer.
Classroom barometer of the Aneroid type.
Official Weather Bureau Map.

UNIT VII. AVIGATION AND INSTRUMENTS

Introductory

This basic unit is designed to serve as an introduction to the more intensive study of air navigation by prospective flyers. A review of geography should make every student solidly familiar with spherical coordinates, time zones, and general physical composition of the world. The principle and operation of the several methods used in getting from place to place through the air should be explained. A functional study will be made of the various instruments in the cockpit exclusive of engine instruments which were taken up in Unit IV.

Outline of Topics

A. Time and location on a sphere:
   1. Earth and motion:
      (a) Latitude.
      (b) Longitude.
   2. Distances:
      (a) Rhumb line.
      (b) Great circle.
   3. Locations:
      (a) Mercator projection.
      (b) Lambert projection.
   4. Time zones.
   5. Magnetic pole:
      (a) Error sources.
      (b) Corrections.

B. Instruments:
   1. Magnetic compass.
   2. Chronometer.
   3. Altimeter.
   4. Air-speed indicator.
   5. Drift indicator.
   6. Directional gyro.
   7. Artificial horizon.
   8. Bank and turn indicator.
   9. Rate of climb indicator.

[1] Numbers refer to sources listed under section entitled *General Source List of Visual Aids.*

C. Charts and maps:
   1. Interpreting:
      (a) Topographic reference.
      (b) Aeronautic reference.
   2. Flight check.
D. Piloting:
   1. Landmarks.
   2. Flying a range.
   3. Using charts—time intervals.
E. Slide-rule operations.
F. Dead reckoning:
   1. Direction and time.
   2. Vector diagrams (with problems).
G. Radio navigation, fundamentals.

Some Selected References

ABC of Aviation. V. W. Page. 1941. Henley.
Aerial Navigation. L. A. Yancey. 1941. Henley.
Air Navigation. P. V. H. Weems. 1938. McGraw-Hill.
Air Pilot Training. Bert Shields. 1942. McGraw-Hill.
Aviation From the Ground Up. G. B. Manly. 1940. Drake & Co.
Aviation Pre-flight Training for High Schools. Hamburg and Tweney. 1942. Pitman.
Avigation. Bradley Jones. 1931. John Wiley & Sons, Inc.
C. A. A. Civilian Pilot Training. Bulletins No. 24, 30. C. A. A. 1940. United States Government Printing Office.
Elements of Aeronautics. Pope and Otis. 1941. World Book Co.
Flight, Meteorology and Aircraft Instruments. Wright, Dyer, and Martin. 1941. American Technical Society.
Safety in Flight. Assen Jordanoff. 1941. Funk & Wagnalls Co.
Simplified Aerial Navigation by Dead Reckoning. A. A. Millan. 1941. Chemical Pub. Co.
Through the Overcast. Assen Jordanoff. 1938. Funk & Wagnalls Co.
Win Your Wings, Vols. I & II. Turner and Dubuque. 1940. Drake & Co.

Some Teaching Aids [1]

Air Pilotage (19).
Dead Reckoning (19).
Airway Aids (19).
Flight Instruments (19).
Instruments (29).
Mapreading—TF 5–12 parts 1 and 2 (35).
Air Navigation (U. S. Signal Corps. No. 1–245) (35).
Desk maps (11).
Wall maps (28).
Air navigation charts (32).

UNIT VIII. GLIDING

Introductory

The development of gliding as a training activity will be discussed, showing its value in the field of plane design, its military uses, and its possibilities as a sport or avocation. A description

[1] Numbers refer to sources listed under section entitled *General Source List of Visual Aids.*

of equipment and methods of conducting gliding training will be outlined.

A few schools in suitable locations may find it possible to undertake actual gliding training under State supervision and in conformity with State and Federal laws. Many schools can provide profitable experience to students in the designing, building and test flying of scale models of full-sized gliders.

Building full-sized gliders or parts of gliders may be undertaken in school shops, but only under expert supervision.

Outline of Topics

A. Historic gliding:
   1. Bird flight.
   2. Man's efforts to copy bird flight.
   3. Later designs.

B. Using air currents to glide.
   1. Slopes conditions.
   2. Thermal conditions.
   3. Weather reports and gliding weather.

C. Types of gliders:
   1. Primary (obsolete) type:
      Training.
   2. Secondary type:
      (a) Single or multiple place.
      (b) Training.
      (c) Soaring.
   3. Soaring type:
      (a) Advanced high performance craft.
      (b) Specifications.
      (c) Performance.

D. Launchings:
   1. Shock cords.
   2. Auto tow.
   3. Winch tow.
   4. Airplane tow.

E. Typical training:
   1. Airport training.
   2. Dual instruction.
   3. Slope training.
   4. Soaring.
   5. Cloud hopping.

F. Design and construction:
   1. Typical design.
   2. Typical frame constructions.
   3. Detail construction.
   4. Performance.

G. Physical and educational Government requirements:
   1. Age.
   2. Physical.
   3. Educaton.
   4. A. T. C. gliders.
   5. Federal and State licensing.

H. Club activities:

1. Membership.
2. Constructing and licensing a glider.
3. Contests.
4. Records.

Some Selected References

Air Pilot Training. Bert Shields. 1942. McGraw-Hill.

Aviation From the Ground Up. G. B. Manly. 1940. Drake & Co.

Aviation Pre-flight Training for High Schools. Hamburg and Tweney. 1942. Pitman.

Elements of Aeronautics. Pope and Otis. 1941. World Book Co.

Flight, First Principles. Wright, Smiley, and Martin. 1941. American Technical Society.

Flight Without Power. L. B. Barringer. 1940. Pitman.

Horizons Unlimited. S. Paul Johnston. 1941. Duell, Sloan & Pearce.

Principles of Flight. Bert Shields. 1942. McGraw-Hill.

Safety in Flight. Assen Jordanoff. 1941. Funk & Wagnalls Co.

Through the Overcast. Assen Jordanoff. 1938. Funk & Wagnalls Co.

Win Your Wings. Vols. I & II. Turner and Dubuque. 1940. Drake & Co.

Your Wings. Assen Jordanoff. 1940. Funk & Wagnalls Co.

Youth Must Fly. (Gliding and Soaring.) E. F. McDonald. 1942. Harper.

Some Teaching Aids [1]

How to Fly (36).
Youth Trains for Aviation (7).
Pilot Problems (19).
Methods of Flight (7).
Air Pilotage (19).
Problems of Flight (13).
Gliders and Light Planes (29).
The Pilot (19).
How to Fly (36) (4).
Airmail Pick-up (1).

UNIT IX. METEOROLOGY II (ADVANCED)

Introductory

A brief review of Unit VI should be made before taking up a more advanced study of cloud types, their formation, and interpretation.

Weather maps should be obtained and studied together with symbols used in weather map making.

A further study of movements of fronts will help the student later in avigation. The vocabulary of the class should be widened in technical terms that form a part of this unit. Practical situations and problems in flying presented by line storms, icing and fog should be discussed.

[1] Numbers refer to sources listed under section entitled *General Source List of Visual Aids.*

Outline of Topics

A. Cloud formations:
   1. Complete analysis of types:
      (a) Cirrus.
      (b) Cirro-cumulus.
      (c) Cirro-stratus.
      (d) Alto-cumulus.
      (e) Alto-stratus.
      (f) Strato-cumulus.
      (g) Stratus.
      (h) Cumulus.
      (i) Nimbo-stratus.
      (j) Cumulo-nimbus.
   2. Direction and velocity of clouds.
   3. Visibility and ceiling measurement.

B. Weather maps:
   1. Symbols used in making.
   2. Interpreting maps.
   3. Map-making.

C. Study of moving fronts:
   1. Cold fronts:
      (a) Slow or retarded.
      (b) Fast moving.
   2. Warm fronts.
   3. Occluded fronts.

D. Fog and cloud formation:
   1. Types of fog:
      (a) Limits to flying.
      (b) Smoke and fog.

E. Icing conditions:
   1. Types of ice formations:
      (a) Effect of each.
      (b) How to avoid.
      (c) De-icing equipment.

F. Recording instruments:
   1. Barometer.
   2. Thermometer.
   3. Hygrometer.
   4. Anemometer.
   5. Radiosonde.

Some Selected References

Books listed in Unit VI are useful in this advanced unit and in addition the following books:

Air Navigation and Meteorology. Richard Duncan. 1941. Goodheart-Wilcox C. A. A. Civilian Pilot Training. Bulletin No. 25. C. A. A. 1940. United States Government Printing Office.

A Pilot's Meteorology. Charles G. Halpine. 1941. Van Nostrand.

Some Teaching Aids [1]

Cloud and Weather (2).
The Air Ocean (19).
Air Masses (19).
Weather (19).
The Weather (13) (14).
Modern Weather Theory and Structure of Storms No. 1–134 (35).
Cloud form charts (33).
Classroom thermometer.
Classroom barometer of the Aneroid type.
Official Weather Bureau Map.

UNIT X. AVIGATION II (ADVANCED)

Introductory

A brief review of Avigation I should be made before taking up the more advanced study of avigation in this unit. Although some of the topics in the outline of Unit X parallel those given in Unit VII, the treatment should be considerably more advanced in character and exhaustive in scope. More practice in the mathematical aspects of avigation is to be given with the aim of developing speed and accuracy in handling practical avigation problems.

Outline of Topics

A. Topographical map making:
   1. Symbols.
   2. Using simple map-making equipment:
      (a) Compass.
      (b) Alidade.
      (c) Level.
   3. Mapping local small area
      (a) Irregular hill.
      (b) Shoreline.
      (c) River and hill.

B. Piloting (sight and map):
   1. Interpreting map:
      (a) Rivers and lakes.
      (b) Roads.
      (c) Railroads.
      (d) Other landmarks.
   2. Time considerations:
      (a) Clouds and fog.
      (b) Wind.

Dead reckoning:
   1. How to lay out a course:
      (a) Plotting course on chart.
      (b) Magnetic variation.
      (c) Compass deviation.
      (d) Compass heading.

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[1] Numbers refer to sources listed under section entitled *General Source List of Visual Aids.*

2. Figuring windage:
   (a) Vector diagrams.
   (b) Problems in drift.
   (c) Problems of ground speed.
   (d) Problems in radius of action.

D. Using radio range:
   1. Review of operation of radio beacon:
      (a) Irregularities of beam.
      (b) Cone of silence.
   2. Orientation on beams:
      (a) Different methods.
      (b) Standard method.
      (c) Wind effects in orientation.
   3. Radio compass, operation:
      (a) Position from radio bearings.
      (b) Running fix from radio bearings.
      (c) Fix from two bearings on one station.
      (d) Errors in radio bearings.
      (e) Allowance for windage.
   4. Fundamentals of radio landings.

E. Fundamentals of celestial navigation.

Some Selected References

Books listed in Unit VII are useful in this advanced unit, and in addition the following books:

C. A. A. Civilian Pilot Training. Bulletin No. 24. C. A. A. 1940. United States Government Printing Office.

Air Navigation and Meteorology. Richard Duncan. 1941. Goodheart-Wilcox.

Aerial Navigation and Meteorology. Lewis A. Yancy. 1941. Henley.

Air Navigation. P. V. H. Weems. 1938. McGraw-Hill.

Some Teaching Aids [1]

Air Pilotage (19).
Dead Reckoning (19).
Airway Aids (19).
Flight Instruments (19).
Instruments (29).
Map reading TF 5–12, parts 1 and 2 (35).
Air Navigation (U. S. Signal Corps, No. 1–245) (35).
Desk maps (11).
Wall maps (28).
Air navigation charts (32).

UNIT XI. COMMUNICATIONS II (ADVANCED)

Introductory

Because of demonstrated need as cited by both the Army and Navy, this unit is included to give pupils a clear understanding of the radio equipment used in military services. The pupils should become used to the technique of clear speech into a microphone and the sound of commands through ear phones. A simple home-constructed public address system with ear phones

[1] Numbers refer to sources listed under section entitled *General Source List of Visual Aids.*

will serve as technical training equipment. A speed of 15 words per minute in sending and receiving radio code signals should be developed. This unit continues instruction started in Unit V to a more advanced stage.

Outline of Topics

A. Two way radiophones:
   1. Equipment:
      (a) Transmitter.
      (b) Receiver.
      (c) Power plant.
      (d) Power source.
   2. Operation:
      (a) Transmitter-receiver.
      (b) Procedure.
      (c). Code words for accuracy.

B. Code and radio compass procedure:
   1. Code abbreviations in common use.
   2. Practice in code receiving.
   3. Practice in code sending.
   4. Getting radio compass bearings.

C. Visual signals:
   1. Airport or carrier flag signals.
   2. Flag communications:
      (a) Semaphore.
      (b) Morse code by flag.
   3. Signal lights and flares.

D. Understanding radio equipment and how it works:
   1. How beams are made directional.
   2. Imposing "A" and "N" on beam.
   3. Multiple beams from one station.
   4. Blind landing equipment and use.
   5. Position from two broadcast signals.
   6. Using loop to follow toward broadcast station.

E. Inaccuracies and errors in radio systems:
   1. Night effects.
   2. Mountain effects.
   3. Bending of beams.

Some Selected References

Airplane Radio Equipment. E. Malloy. 1941. Chemical Publishing Co.
The Radio Amateur's Handbook (Defense Edition). A. R. R. L. 1942. American Radio Relay League, Hartford, Conn.
Books listed in Unit V are useful in this advanced unit.

Some Teaching Aids [1]

Radio and Control (19).
Electrons on Parade—RCA (27).
Radio and Aircraft (29).
Wizardry of Wireless (35).
Communications No. 11–1 (35).

[1] Numbers refer to sources listed under section entitled *General Source List of Visual Aids.*

SUMMARY CHART OF SELECTED REFERENCES

[This chart includes only the books listed under each unit. Besides bringing together in one place the references for the 11 units, the chart is designed to show which books listed have the widest utility. For details concerning the publisher and date of publication refer to the unit outlines. Addresses of publishers are given later in this leaflet]

	I. Orientation	II. Structure	III. Aerodynamics	IV. Power plants	V. Communications I	VI. Meteorology I	VII. Avigation I	VIII. Gliding	IX. Meteorology II	X. Avigation II	XI. Communications II
American Radio Relay League:											
Learning the Radio Telegraph Code					x						
The Radio Amateur's Handbook					x						x
American Technical Society. Flight (4 vols.):											
1. Wright, Smiley, and Martin. First Principles	x		x								
2. Wright, Dyer, and Martin. Construction and Maintenance		x									
3. Wright, Dyer, and Martin. Meteorology and Aircraft Instrument						x					
4. Kuns. Aviation Engines				x							
Arnold, H. H. This Flying Game	x										
Barringer, L. B. Flight Without Power								x			
Baughman, Harold E. Baughman's Aviation Dictionary and Reference Guide		x									
Black, Archibald. The Story of Flying	x										
Brimm, D. J., and Boggess, H. E.:											
Aircraft Maintenance		x									
Aircraft Engine Maintenance				x							
Brown, Willis C. Airplane Models and Aviation			x								
Chatfield, Taylor and Ober. Airplane and Its Engine				x							
Chemical Publishing Co. The Meteorology Glossary						x					
Civil Aeronautics Administration:											
Civil Pilot Training Manual. Bulletin No. 23			x								
Practical Air Navigation. Bulletin No. 24							x			x	
Meteorology for Pilots. Bulletin No. 25						x			x		
Aerodynamics for Pilots. Bulletin No. 26			x								
Pilots' Airplane Manual. Bulletin No. 27		x									
Pilots' Power Plant Manual. Bulletin No. 28				x							
Pilots' Radio Manual. Bulletin No. 29					x						x
Ground Instructors' Manual. Bulletin No. 30.			x	x		x	x				
Duncan, Richard. Air Navigation and Meteorology									x	x	
Finch, Trewartha, Shearer, Candle. Elementary Meteorology						x					

	I. Orientation	II. Structure	III. Aerodynamics	IV. Power Plants	V. Communications I	VI. Meteorology I	VII. Aviation I	VIII. Gliding	IX. Meteorology II.	X. Aviation II	XI. Communications II
Ford, H. S. What the Citizen should Know About The Army	x										
Fraser, Chelsea. Famous American Fliers	x										
Gillmer, Thoman C., and Nietsch, Herman E. Simplified Theory of Flight			x								
Grant, Charles H. Model Airplane Design and Theory of Flight			x								
Halpine, Charles G. A Pilot's Meteorology						x					
Hamburg and Tweney. Aviation Preflight Training in High Schools	x	x	x	x	x	x	x	x			
Hartney, Harold E.:											
Aircraft Spotters Guide		x									
What the Citizen Should Know About the Air Force	x										
Hoag, J. Barton. Basic Radio					x						
Johnston, S. P. Horizons Unlimited	x	x	x					x			
Jones, Bradley. Avigation							x				
Jordanoff, Assen:											
Through the Overcast				x	x	x	x				
Safety in Flight		x		x	x	x	x				
Leyson, Burr. Wings of Defense	x										
McDonald, Eugene F. Youth Must Fly								x			
McMillan, A. A. Simplified Aerial Navigation							x				
Manly, G. B.:											
Aviation From the Ground Up	x			x		x	x				
Aircraft Powerplant Manual				x							
Miller, H. B. Navy Wings	x										
Mingos, Howard. The Aircraft Yearbook (Current Year)		x									
Molloy, E. Airplane Radio Equipment					x						x
Morgan, Alfred:											
Boy's Book of Radio					x						
Getting Acquainted With Radio					x						
Norcross, Carl and Quinn, James D., Jr. The Aviation Mechanic		x	x	x							
Ott, Lester. Aircraft Spotter		x									
Page, Victor W. A B C of Aviation		x	x	x			x				
Pitkin, Walter B., Jr. What's That Plane: Friend or Foe?		x									
Pope, Francis and Otis, Arthur. Elements of Aeronautics		x	x	x	x	x	x	x			
Shields, Bert:											
Principles of Aircraft Engines				x							
Principles of Flight			x					x			

	I. Orientation	II. Structure	III. Aerodynamics	IV. Power Plants	V. Communications I	VI. Meteorology I	VII. Aviation I	VIII. Gliding	IX. Meteorology II.	X. Aviation II	XI. Communications II
Shields, Bert—Contined.											
Air Pilot Training		x	x			x	x	x			
Turner, Roscoe and Dubuque, Jean H. Win Your Wings:											
Vol. 1	x		x			x	x				
Vol. 2		x		x	x		x				
Watson, Welch & Eby. Understanding Radio					x						
Weems, P. V. H. Air Navigation. 2d ed						x	x		x	x	
Winter, William. The Model Aircraft Handbook			x								
Yancey, Lewis A. Aerial Navigation and Meteorology						x	x				
Yates, Raymond F. Model Gasoline Engine				x							
Zier, Avrum. Aerodynamics for Model Aircraft			x								

GENERAL SOURCE LIST OF VISUAL AIDS

[This general source list of visual aids has been compiled by consulting a variety of extant lists. It includes moving pictures, slide films, maps, charts, and other visual aids. Catalogs of films may be obtained from many of the sources. The extension divisions of many State colleges and universities have libraries of films and slides for loan and their lists should be consulted for areonautical materials]

1. ALL AMERICAN AVIATION, INC., 200 West Ninth St., Wilmington, Del.
   Air-mail Pickup ..... 35 mm.—color.
2. AMERICAN FILM CENTER, INC., 45 Rockefeller Plaza, New York, N. Y.
   Cloud and Weather.
   Wings of Youth: Training of Canadian Fliers.
3. BELL AIRCRAFT CORP., Advertising Dept., Buffalo, N. Y.
   The Airacobra.
4. BELL AND HOWELL (Agencies in New York, Chicago, Hollywood, Washington, D. C.).
   Aviation Engines ..... 1 reel, 16 mm.—sound.
   Curtiss-Wright Answers the Call for Quantity. 1 reel, 16 mm.—sound.
   How to Fly ..... 1 reel, 16 mm.—sound.
   Aerodynamics·
      Part 1. Properties of Air ..... 1 reel, 16 mm.—sound.
      Part 2. Lift ..... 1 reel, 16 mm.—sound.
      Part 3. Air Resistance and Streamlining. 1 reel, 16 mm.—sound.
   Aircurrent and Theory of Streamlining ..... 1 reel, 16 mm.—sound.
5. BOY SCOUTS OF AMERICA, 2 Park Avenue, New York, N. Y.
   Aviation (pamphlet).
   An illustrated pamphlet containing material on types of aircraft, tools and materials for model aircraft construction.
6. BRANDON FILMS, INC., 1600 Broadway, New York, N. Y.
   Aviation Engine ..... 1 reel, 16 mm.—sound
7. BRAY STUDIOS, INC., 729 Seventh Avenue, New York, N. Y.
   Youth Trains for Aviation ..... 1 reel, 16 mm.—sound.
   Methods of Flight ..... 2 reels, 16 mm.—sound.
   Essential Parts and Types of Planes ..... 1 reel, 16 mm.—sound.
   Youth Takes to Wings ..... 2 reels, 16 mm.—sound.
   Aerodynamics ..... 1 reel, 16 mm.—sound.
      Part 1. Properties of Air ..... 1 reel, 16 mm.—sound.
      Part 2. Lift ..... 1 reel, 16 mm.—sound.
      Part 3. Air Resistance and Streamlining. 1 reel, 16 mm.—sound.
8. CASTLE FILMS, RCA Building, New York, N. Y.
   Story of Aviation ..... 3 reels—sound.
9. COAST ARTILLERY CORPS (Request from Corps Area Commander).
   Identification of Aircraft ..... Film strip, 35 mm.
10. CONSOLIDATED AIRCRAFT CORPORATION, Publicity Dept., San Diego, Calif.
    The Building of PBY's ..... 1 reel, 16 mm.—sound.
11. DENOYER-GEPPERT, Chicago, Ill.
    Butterfly World Map ..... Desk maps 11 x 16 and 16 x 22.
12. EASTMAN KODAK CO., Rochester, N. Y.
    Principles of Flight ..... 1 reel, 16 mm.—sound.

13. ERPI CLASSROOM FILMS, 35—11 35th Avenue, Long Island City, N. Y.
Problems of Flight---------- 1 reel, 16 mm.—sound.
Theory of Flight---------- 1 reel, 16 mm.—sound.
The Weather---------- 1 reel, 16 mm.—sound.
14. FILMS, INCORPORATED, 330 West 42d Street, New York, N. Y.
Conquest in the Air---------- 4 feels—sound.
The Weather---------- 1 reel, 16 mm.—sound.
15. FRANKLIN INSTITUTE OF PHILADELPHIA, Pa.
Smoke Streams---------- 2 reels, 16 mm.
16. GOODYEAR TIRE & RUBBER CO., Akron, Ohio.
The Air Fleet---------- 1 reel—silent.
17. GUTLOHN, WALTER O., 35 W. 45th Street, New York, N. Y.
History of Aviation---------- 3 reels, 16-mm.—sound.
Autogyro---------- 1 reel, 16-mm.—sound.
Airplane Welding---------- 2 reels, 16-mm.—silent.
18. HAMILTON PROPELLER CO., Hartford, Conn.
Keep 'Em Flying (propellers)---------- 1 reel, 16-mm.—sound.
19. JAM HANDY, 2900 East Grand Boulevard, Detroit, Mich.
24 slide films, as follows:

Men and Wings.	Fuel and Feed.
Today's Wings.	Airplane Ignition.
Aircraft Regulation.	Engine Instruments.
The Pilot.	Parachutes.
Traffic.	The Air Ocean.
Radio and Control.	Air Masses.
Lift and Drag.	Weather.
Wing Forces.	Air Pilotage.
Stability.	Dead Reckoning.
Plane Performance.	Airways Aids.
Check and Double Check.	Flight Instruments.
The Airplane Engine.	Pilot Problems.

20. LOCKHEED AIRCRAFT CORPORATION, Public Relations Dept., Burbank, Calif.
Look to Lockheed for Leadership---------- 1 reel, 16-mm.—sound.
21. MARCH OF TIME, Time Inc., Publishers, New York, N. Y.; Washington, D. C.
Sailors With Wings---------- 1 reel, 16-mm.—sound.
22. NATIONAL AERONAUTIC ASSOCIATION, 718 Jackson Place, Washington, D. C.
Air Youth Division, Charts 1 and 2.
Chart 1 gives clearly labeled names of parts of a modern sports plane.
Chart 2 gives 3 view silhouettes of some of the leading planes of the United States and three other nations.
23. NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS. Attention: Miss Muller. Washington, D. C.
General film No. 2---------- 1 reel, 16-mm.—silent.
(Test methods of N. A. C. A.)
24. NONTHEATRICAL PICTURES CORPORATION, 165 W. 46th Street, New York, N. Y.
Airscrew---------- 2 reels—sound.
25. OFFICE FOR EMERGENCY MANAGEMENT, Film Unit, Washington, D. C.
Building a Bomber---------- 1 reel, 16-mm.—sound.

26. PHOTO TEMPLATE LABORATORIES, 3734 San Fernando Road, Glendale, Calif.
Charts 20″ x 30″ on Aircraft Engines, Fuel and Oil Systems and Airplane Structures.

27. RADIO CORPORATION OF AMERICA, New York, N. Y.
Electrons on Parade_____ 1 reel, 16 mm.—sound

28. RAND McNALLY CO., Chicago, Ill.
A World Map for the Air Age 60″ x 60″.
Amateur Radio Map of the World 33″ x 44″.

29. SOCIETY FOR VISUAL EDUCATION, 100 E. Ohio St., Chicago, Ill.
The slide films available cover the following subjects:

Historical.
Construction.
Engine.
Instruments.
Propellers.
Lighter-than-air.
Land Planes.
Seaplanes.
Air chutes.
Maintenance.
Autogyros.
Gliders and Light Planes.
Aerial Photography.
Aircraft in Other Industries.
Famous Flights and Fliers.
Army Aircraft.
Navy Aircraft.
Radio and Aircraft.
Accessories.
Special Equipment.
Aircraft Schools.

30. TRADE FILMS, 933 Seward St., Los Angeles, Calif.
The 18 slide films available cover the following subjects:

The Engineer's Relation to Production.
The Engineer's Relation to Assembly.
Riveting.
Blueprint Reading.
Gas Welding.
Arc Welding.
Mills.
Heat Treatment of Aluminum Alloys.
Safety.
Resistance Welding.
Jigs and Fixtures.
Methods of Fabrication.
Methods of Assembly.
Forming Machines.
Cutting Machines.
Lathes.
Processings.
The Component Parts of an Airplane.

31. U. S. ARMY, AIR CORPS, Army Air Force, Hq. Adj. Gen. Photo Section, War Department, Washington, D. C.
Wings of the Army, 1940.
History of_____ 4 reels—sound

32. U. S. GEODETIC SURVEY, Washington, D. C.
Sectional Aeronautic Charts.
Air Navigation charts covering the entire U. S. available for all localities.

33. GOVERNMENT PRINTING OFFICE, Washington, D. C.
Cloud Forms. A chart prepared by the U. S. Weather Bureau showing different types of clouds and heights at which they occur.

34. NAVY DEPARTMENT, Washington, D. C.
Wings of Gold and Eyes of the Navy_____4 reels, 35 mm.—sound.
May be secured from Cadet Selection Boards at Albany, N. Y.; Baltimore, Md.; Birmingham, Ala.; Boston, Mass.; Buffalo, N. Y.; Chicago, Ill.; Cincinnati, Ohio; Cleveland, Ohio; Dallas, Tex.; Indianapolis, Ind.; Denver, Colo.; Des Moines, Iowa; Detroit, Mich; Houston, Tex.; Kansas City, Mo.; Little Rock, Ark.; Los Angeles, Calif.; Louis-

ville, Ky.; Macon, Ga.; Minneapolis, Minn.; Nashville, Tenn.; New Haven, Conn.; New Orleans, La.; New York, N. Y.; Omaha, Nebr.; Philadelphia, Pa.; Pittsburgh, Pa.; Portland, Oreg.; Raleigh, N. C.; Richmond, Va.; Salt Lake City, Utah; San Francisco, Calif.; Seattle, Wash.; Springfield, Mass.; and St. Louis, Mo.

35. U. S. ARMY, SIGNAL CORPS, Washington, D. C.

These 16-mm. sound films may be made available for school use by September 1942 if negotiations now under way are successful. Look for future announcement in *Education for Victory*, U. S. Office of Education's biweekly publication.

Aircraft Engines	Film No. 1–135, 1–136, 1–137.
Aerodynamics	Film No. 1–160, 1–161.
Airplane Structure:	
Parts I and II	Film No. 1–211.
Part III	1–213.
Part IV	1–214.
Part V	1–215.
Part VI	1–312.
Part VII	1–323, 1–246.
Air Navigation	Film No. 1–245.
Aerial Navigation	Film No. TF1–328.
Modern Weather Theory and Structure of Storms.	Film No. 1–134.
Map Reading: Parts I and II	Film No. TF5–12.
Communications No. 11–1	Film strip.
Wizardry of Wireless	2 reels—sound.

36. VISUAL EDUCATION SERVICE, 131 Clarendon St., Boston, Mass.

How to Fly	1 reel, 16 mm.—sound.

37. VULTEE AIRCRAFT, INC., Public Relations Dept., Vultee Field, Calif.

Messerschmitt 110	1 reel, 16 mm.—silent.

38. WESTERN AIR LINES, 501 W. 6th Street, Los Angeles, Calif.

Color slides	1 series, on military aircraft.

39. WRIGHT AERONAUTICAL CORPORATION, Public Relations Dept., Paterson, N. J.

Wright Builds for Air Supremacy	2 and 5 reel versions, 16 mm. and 35 mm.

LIST OF PUBLISHERS AND THEIR ADDRESSES

Aero Publishers, Inc., Glendale, Calif.
Aeronautical Chamber of Commerce of America, Inc., 30 Rockefeller Plaza, New York City.
American Radio Relay League, West Hartford, Conn.
American Technical Society, 850 East 58th Street, Chicago, Ill.
Appleton-Century Co., Inc., 35 West 32d Street, New York City.

Chemical Publishing Co., 148 Lafayette Street, New York City.
Crowell. Thomas Crowell Co., 432 4th Avenue, New York City.

Dodd, Mead & Co., Inc., 443–449 4th Avenue, New York City.
Drake & Co., Inc., 179 North Michigan Avenue, Chicago, Ill.
Duell, Sloan, & Pearce, 270 Madison Avenue, New York City.
Dutton & Co., Inc., 286–302 4th Avenue, New York City.

Funk & Wagnalls Co., 354–360 4th Avenue, New York City.

Goodheart-Wilcox Co., Inc., 2009 South Michigan Avenue, Chicago, Ill.

Harcourt, Brace & Co., Inc., 383 Madison Avenue, New York City.
Harper & Brothers, 49 East 33d Street, New York City.
Heath. D. C. Heath & Co., 285 Columbus Avenue, Boston, Mass.
Henley. The Norman W. Henley Publishing Co., 2 West 45th Street, New York City.

Jay Publishing Co., 551 5th Avenue, New York City.

McGraw-Hill Book Co., Inc., 330 West 42d Street, New York City.

National Aeronautics Council, Inc., 37 West 47th Street, New York City.
Norton & Co., Inc., 70 5th Avenue, New York City.

Penquin Books, 300 4th Avenue, New York City.
Pitman Publishing Corporation, 2–6 West 45th Street, New York City.

The Ronald Press Co., 15 East 26th Street, New York City.

United States Government Printing Office, Washington, D. C.

Van Nostrand. D. Van Nostrand Co., Inc., 250 4th Avenue, New York City.

Whittlesey House (McGraw-Hill Book Co.), 330 West 42d Street, New York City.
World Book Co., 313 Park Hill Avenue, Yonkers-on-Hudson, N. Y.

APPENDIX A. ARMY AIR FORCE AVIATION CADET TRAINING

(As of June 15, 1942)

The Army Air Forces aviation cadet starts his training by reporting at a pre-flight school center located in any one of the three Air Forces Training Centers which have headquarters at Santa Ana, Calif., Maxwell Field, Ala., and Randolph Field, Tex. Here he is given special psychological and physical examinations to determine the particular type of duty for which he is best suited.

The cadet selected for pilot training spends 9 weeks at the pre-flight school, where he takes an intensive course in military training, as well as preliminary ground work. On completion of this training the pilot cadet is sent to an elementary flying school for a period of 9 weeks. There he is given 70 hours of instruction on lightweight, low-powered training planes, together with courses in the fundamentals of engine mechanics, aircraft structure, and flight characteristics, meteorology, maps and air navigation, as well as a vigorous schedule of physical training.

After completing the work in the pre-flight school, he is sent to a Basic Training School for 9 weeks' instruction. Approximately half of his time is spent in flying heavier types of planes with 450-h. p. engines in which he practices various basic air maneuvers. He studies instrument flying and practices take-offs and landings at night with the aid of flood and landing lights. The remainder of his time is spent in classroom work where he learns to operate radio equipment, becomes familiar with the service-type engines, and studies such subjects as air navigation and meteorology. It is at this school that the cadet catches the true spirit of the Army Air Forces. He becomes imbued with the discipline which keeps him erect and alert. He becomes an active part of a great organization and takes pride in its traditions.

When the pilot cadet finishes his basic training, he is a real pilot, but he has not yet learned to use his plane as an air weapon. It is at the Advanced Training School that he learns to fly speedy fighters and bombers with their highly supercharged engines. He learns the use of armament and becomes an expert in air combat tactics. The particular nature of his training will be determined by what he has selected as his specialty. He may become a bombardment pilot and specialize on multi-engine bombers; or a fighter pilot and concentrate on the smaller combat planes; or he may point for a liaison pilot's assignment. Upon successful completion of this advanced training the pilot cadet gets his coveted "wings" and is commissioned as a second lieutenant.

Other cadets selected for bombardier or navigator training follow other courses on the journey to their "wings." Both spend 9 weeks at a pre-flight school where they get instruction in fundamentals, elementary military training, as

well as physical conditioning. The bombardier cadet proceeds to one of the specialized schools which are located in the southwestern part of the country where atmospheric conditions are especially suitable for high altitude bombing practice. Here he puts the theories of bombardment into actual practice. He learns to operate gyroscopes, the secret bombsights, bomb racks, and controls. He spends a great deal of his time in the air carrying out mock bombing missions and learns the techniques of bombardier-pilot coordination. The duration of this course is 12 weeks.

The navigator cadet goes from the pre-flight school to one of the special schools located at Albany, Ga., Kelly Field, Tex., or Mather Field, Calif. During this 15-week course he studies the principles involved in the operation of a host of instruments, such as the directional gyro, the magnetic compass, airspeed meter, and the octant. He learns to interpret maps and charts and studies star identification. During many hours of actual flight over varied terrain he becomes an expert in pilotage, dead-reckoning, and celestial and radio navigation.

Both the bombardier cadet and the navigator cadet then receive their "wings" after completing a 5-week course in a special school of gunnery, and are commissioned as second lieutenants.

Now, although the three flying officers have their "wings," they are not yet ready for actual combat. Pilots must learn to work with other flying personnel. Bomber crews must practice together so that they may function in perfect coordination. From 6 to 12 weeks is spent in this "operational training" before the men are finally launched as finished winged warriors of the United States Army Air Forces.

APPENDIX B. NAVAL AVIATION CADET TRAINING

(As of June 15, 1942)

Upon being called to active duty in the Naval Reserve the student will be ordered to one of the pre-flight schools at the University of Iowa, North Carolina, Georgia, or St Mary's. Here he will undergo a strenuous program of physical hardening as well as a more advanced ground school course. In addition, he will undergo the first steps of indoctrination in becoming a naval or a marine officer. He will study naval lore, history, and leadership.

After 3 months of this intensive instruction these young men will be ready to begin actual flying. For this phase they will be ordered to one of the many preliminary flight schools which dot the country. This will be their first contact with naval aircraft. But more, their ground school education will go on apace and here the preliminary work done at the pre-aviation-cadet training in high schools will show up to advantage.

Time is precious, and the course is accelerated at a rapid rate. In addition to the theoretical study of engineering, navigation, gunnery and tactics, the student's time is filled with practical work with these as well as many other studies. During this entire period flight training is taking place.

At the end of 3 months the student progresses on to the basic flight schools at Pensacola or Corpus Christi, where all of his work both flying and ground school, become greatly advanced. Three months will be devoted to learning to apply the basic lessons he has studied up to this time. Following this, the student will receive his wings. Then follows 2 months' specialized training after which the young aviator is ready to move on to the Fleet as a skilled fighter pilot, a well-trained dive-bomber pilot, or perhaps carrying the tremendous responsibility of piloting a huge patrol bomber. Moreover, he is now an officer, mentally alert, tough physically, and fully prepared to take the offensive.

In flying torpedo planes, fighters, or scout dive-bombers the new aviator will operate from the decks of an airplane carrier. If the pilot is assigned to patrol planes he will operate from shore bases, or perhaps from seaplane tenders. In any event he will be a naval officer who is a well-trained aviator, qualified in every phase of aeronautics, and well prepared for a lifetime profession.

"Keep 'em flying!"